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Optimization and Characterization of Al5052/ Sic Metal Matrix Composite

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Abstract:
The investigations on the characterization and optimization of Al052 base metal matrix composite (MMC) reinforced with Silicon Carbide (SiC) samples are reported in this paper.Aluminium MMC prepared with SiC powder of particle size of less than 60µm , with weight ratios of 2 ,4 & 5 % .These composites were prepared by usingcoal fired metal castingtechnique. Aseriesoftestswere conducted to evaluate mechanical properties such as tensile strength, yield strength, impact streng thand hardness for the specimen.The results are revealingthat thetensilestrength increased with increase inwt.% ofreinforcement particles in the matrix up to 4% and tensile strengthdecreased for 5 % addition of reinforcement in the matrix,. Investigations showthat the MMC with 4% of SiC have better mechanical properties i.e.tensile strength yield strength and hardness, impact in below and above reinforcement matrix .

Keywords: Al-5052, Mechanical properties, MMC, SiC powder, Metal casting.

1. INTRODUCTION

In the last two decades research shifted has tocompositematerials tomeet the global demands this led to the concept of combining different materials. Metal matrix composites(MMCs) are increasingly becoming attractive materials For advance daero space applications because their properties can be tailored through the addition of selected reinforcements. Composite material is a material composed of two or more distinct phases are combined MMC is prepared with the help of introducing reinforcement particles in the matrix of any metal. These particles increases the properties like abrasivewear resistance, hardness, strength to weight ratio, stiffness and many thermal properties.

The commonly used metallic matrices include Al, Mg, Ti, Cu, Si and their alloys.

Thesealloys are preferred matrix materials for the production of MMCs. The reinforcements beingused are fibers, whiskers, and particulates In the present investigation Aluminium 5052 alloy was used as thematrix material.Among the various Aluminium alloys, Aluminium 5052 alloy is typically characterized by properties such as corrosion resistance, cast ability, and high strengthweight ratio.

Due these good properties Al 5052 is used in construction of aircraft structures, such aswings and fuselages and SCUBA tanks , automobile pannels , marine applications.

Table.1. The chemical composition of Al6061 is shown in Table 1.

Elements	Si	Fe	Cu	Mn	Mg	Cr	Zn	others	Al
Content	0.25	0.4	0.1	0.1	2.2 – 2.8	0.15-0.25	0.1	0.15	Remaing

2. EXPERIMENTATION

2.1 Silicon carbide Reinforcement:

SiC is a new graphene which is having attractive layered structure. It is very strong and Good electrical conductivity. It gained interest in the scientific community as a potential replacement.

2.2 Preparation of the metal matrix composite:

Al-5052 was used as the matrix and Silicon carbide (SiC) as reinforcement. Themetal matrix composites were prepared using sand casting technique by varying the SiCin wt.% of 2%,4%,5% of 60 µm particle size.

Appropriately estimated amount of Aluminium alloy was fed into the sand casting furnace and was melted at 700◦c. An appropriate amount of (1% of the wt. of base metal) SiCparticles were added slowly to the molten Aluminium metal.

Figure.1.

The SiC powder was pre-heated up to 500◦c to remove the moisture (if any) and then it was added to the molten metal.Then the mixture is transferred to a pure sand casting mould to get the required specimens shown in fig..The same

procedure was followed to get the MMCs of other wt. % i.e. 2 %, 4 %and 5%.

Casting outputs:

Figure.2. Before machining

Figure.2.1After Machining in standard dimensions

2.3Testing of the Material

The specimens were tested for their mechanical properties i.e. tensile strength, Impact strength and hardness and also tested for electrical conductivity for 2, 4,5% MMC. These specimens are in ASTM Standards.

2.3.1Hardness Test:

The hardness test was carried out on the base metal and metal matrix samples by using Brinell Hardness Testing Machine.

3 (a) 2% SiC with 100X **3 (b) 4% SiCwith 100X** **3(c)5 % SiCwith 100X**

Figure.3. Hardness testing

2.3.2Tensile Testing:

Test was carried out on a computerized UTM. The tested specim ens were shown in fig.4

20 % SiC

40 % SiC

50 % SiC

Figure.3.1SiC with 100X

2.3.3 Impact Test:

The specimens were subjected to Charpy impact test to me asure the impact strength

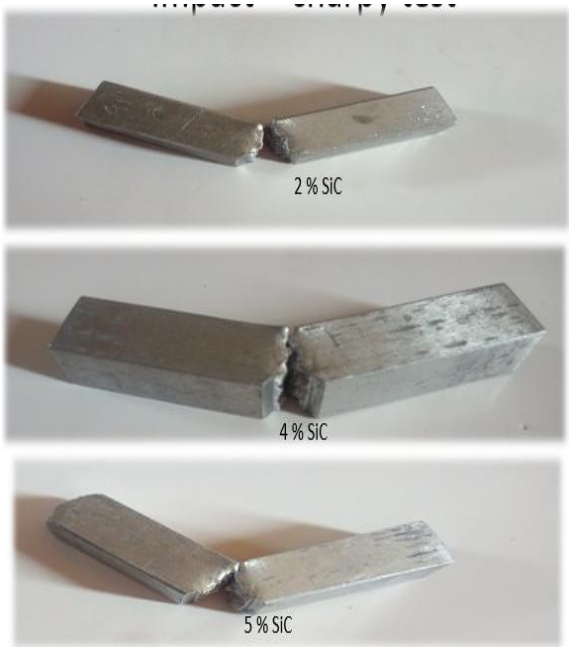


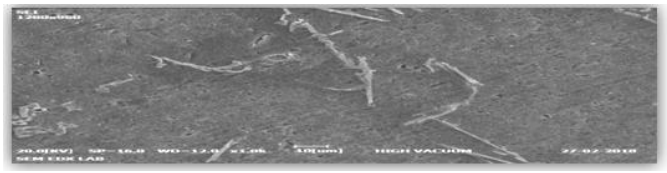
Figure .3.2SiCwith 100X

3.RESULTS AND DISCUSSIONS:

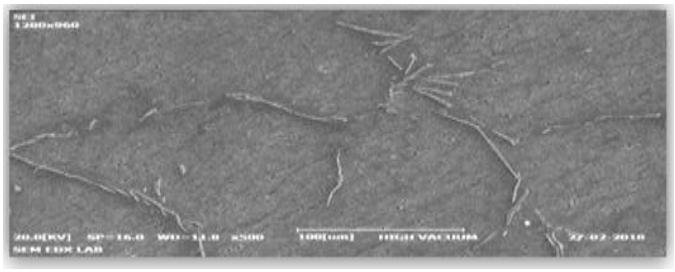
3.1Microstructure:

The microstructure of the specimen was observed by using computerized microscope .The structures were shown in Fig.4 for different compositions of MoS2.Microstructure studies clearly reveal that the distribution ofSiCin the matrix in fig 4(a) is poor. It is observed from the fig 4(c)the reinforced particles are in the form of small lumps. Figure 4 (b) clearly reveal that there is fairly uniform distribution of Sic throughout

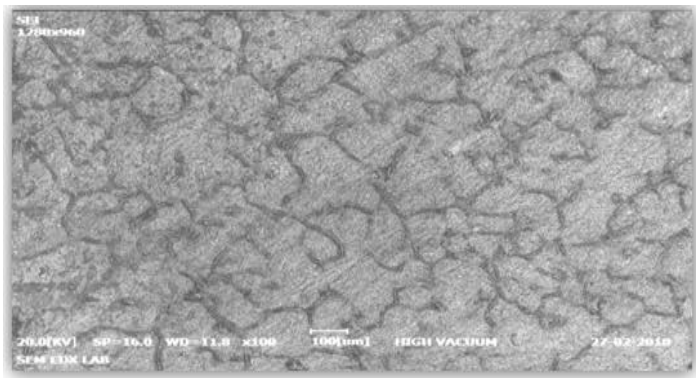
the MMC. From the microstructures it is observed that Al5052 is able to dissolve SiCparticles up to 4% with effectively. There after by increasing the wt % Al5052 is having less capability of dissolving the SiC. The hardness can decrease wt % of SiC and These the Impact resist can increase wt % of SiC



4 a (i)

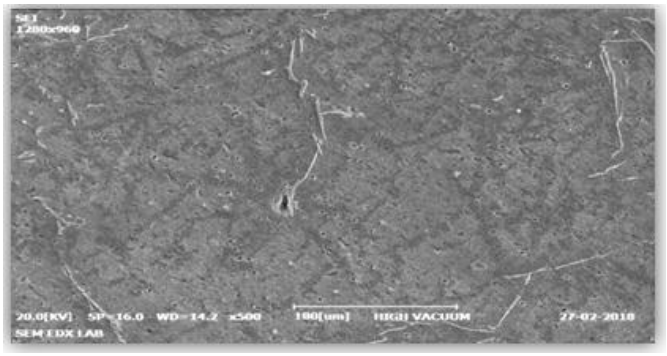


4 a (ii)

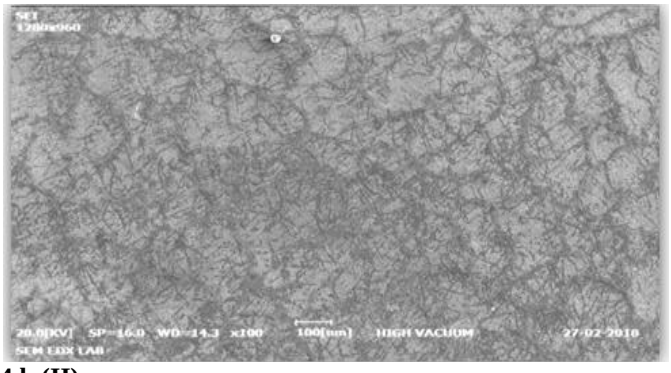


4 a (iii)

Figure.4. a) MMC with 2 % SiCwith 100X

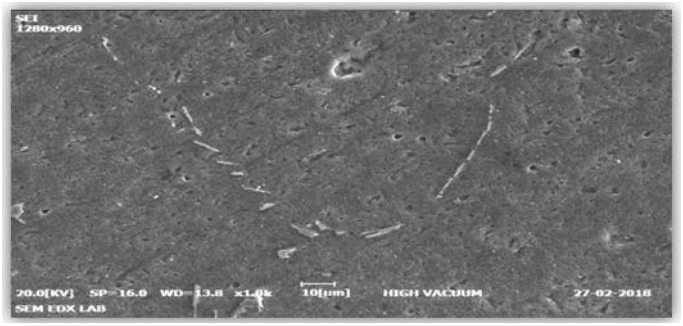


4 b (I)

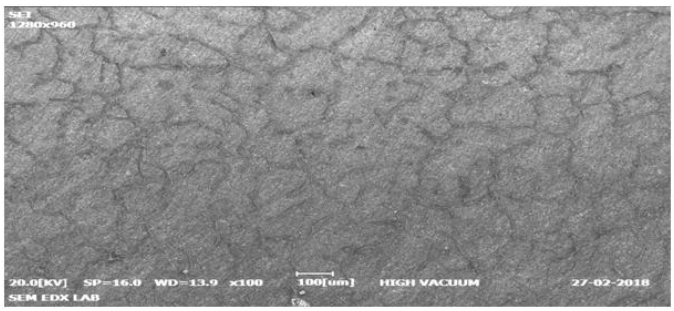


4 b (II)

Figure.4. b) MMC with 4 % SiCwith 100X



4 c (I)



4 c (II)

Figure.4. c) MMC with 5 % SiC with 100X

4. CONCLUSIONS:

The present work deals with the preparation and characterization of Al-SiCMetal Matrix composite. The following conclusions are made from the study.

1. Al 5052/ SiC MMCs were successfully fabricated.
2. The hardness of the MMC is found to be maximum for 4% SiC.
3. The tensile strength of the MMC is found to be maximum for 4% SiC.
4. MMC with 4% SiC is found to be the best material based on the characterization of the mechanical properties.

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